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Pettigrew et al.

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[45] **Date of Patent: Jun. 4, 1996**

[54] **PORTABLE COUNTER AND DATA STORAGE SYSTEM**

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[73] Assignee: **Ronald K. Pettigrew**, Carmel, Ind.

[21] Appl. No.: **264,478**

[22] Filed: **Jun. 23, 1994**

[51] **Int. Cl.**[6] **G06M 1/02**; G06M 1/274; G07C 9/00

[52] **U.S. Cl.** **377/6**; 340/556; 377/53

[58] **Field of Search** 377/6, 53; 340/556

[56] **References Cited**

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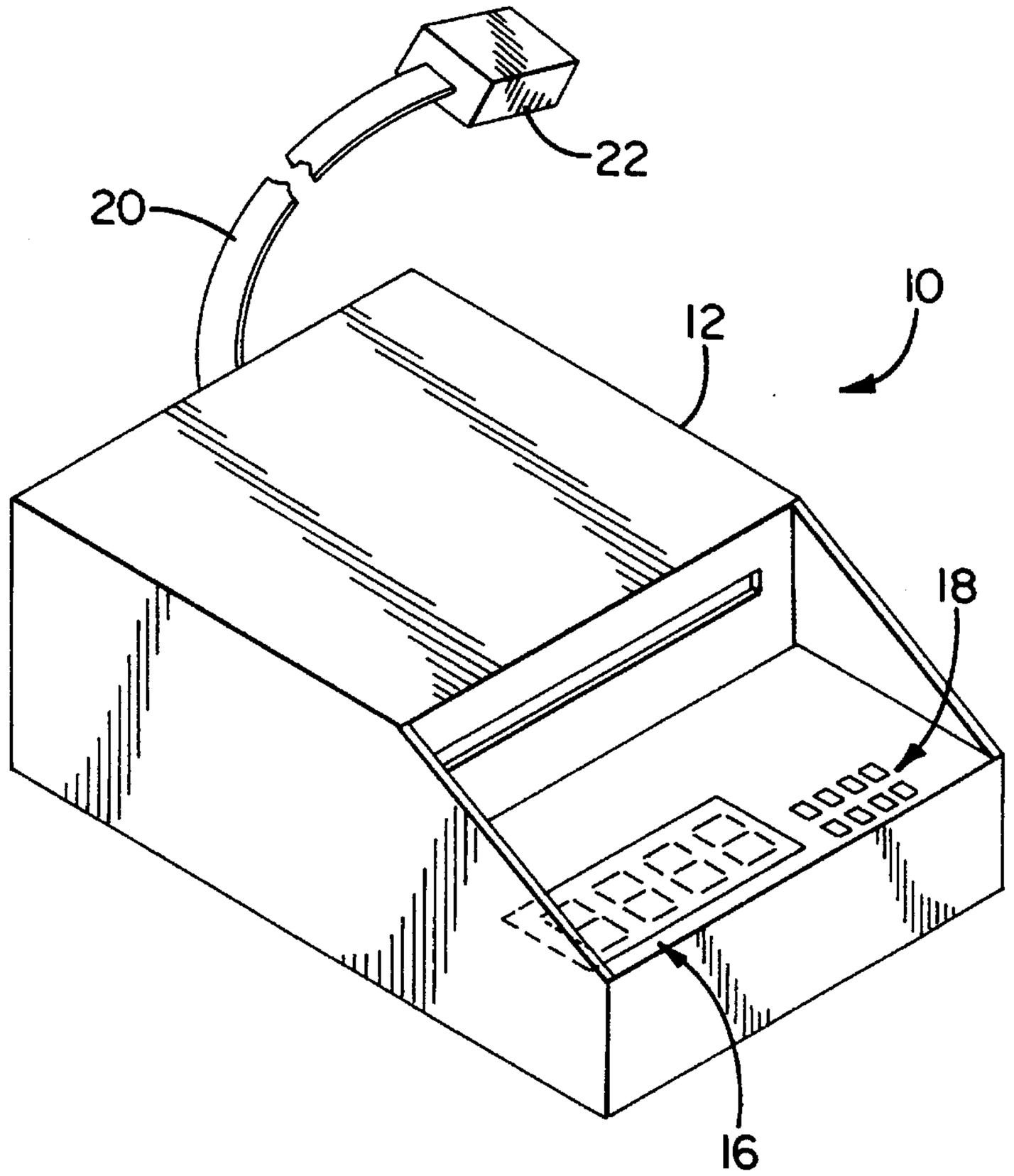
Michael J. McCarthy, *James Bond Hits the Supermarket: Stores Snoop on Shoppers' Habits to Boost Sales,* Wall Street Journal, Aug. 25, 1993.

Primary Examiner—John S. Heyman
Attorney, Agent, or Firm—Leydig, Voit & Mayer, Ltd.

[57] **ABSTRACT**

A compact counting and data storage system includes control circuitry coupled with a detector and input selector to enable monitoring of traffic within a selected area for a selected count interval. The system also includes a readily removable data storage unit.

7 Claims, 6 Drawing Sheets



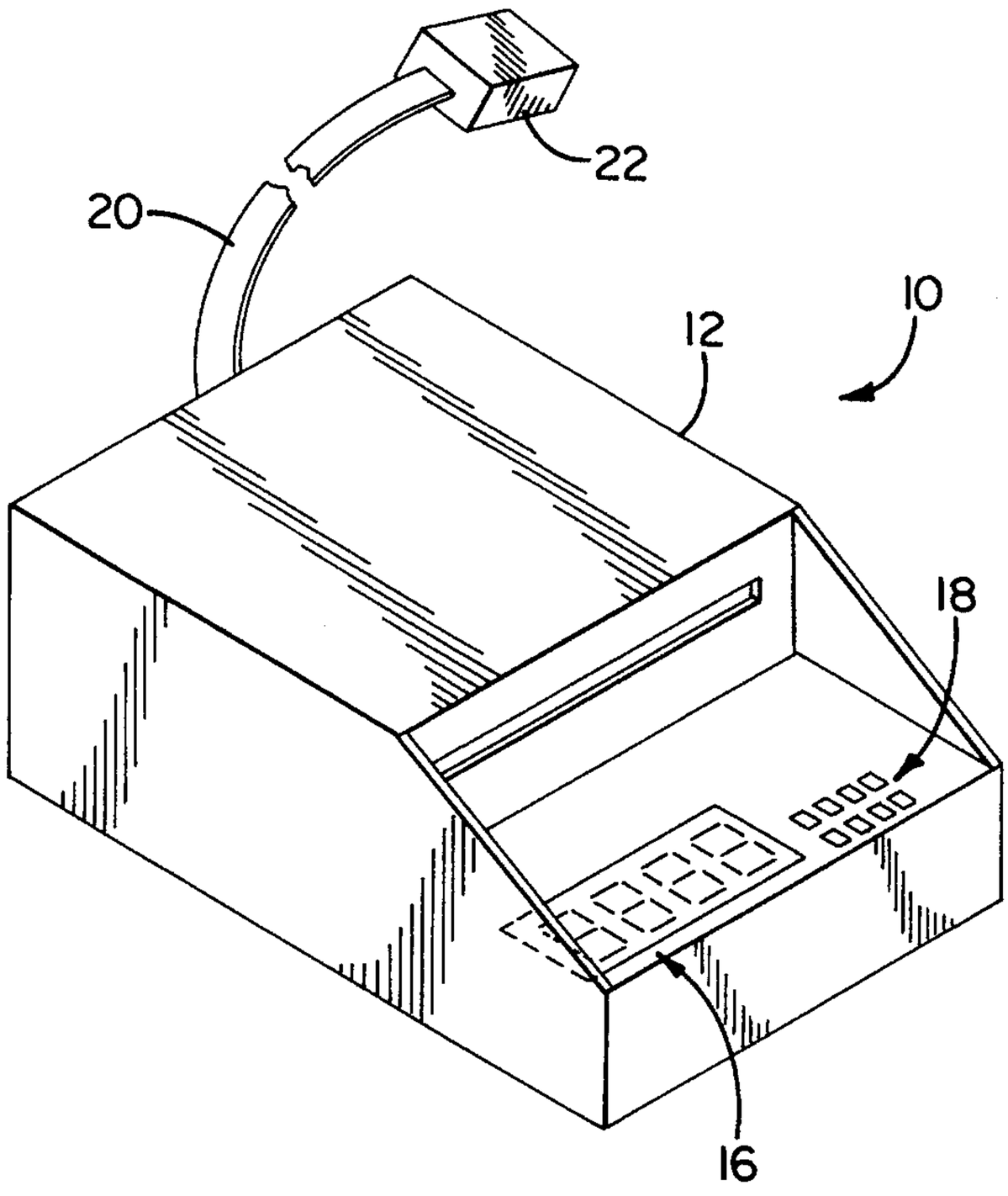

22
20
10
12
18
16

FIG. 1

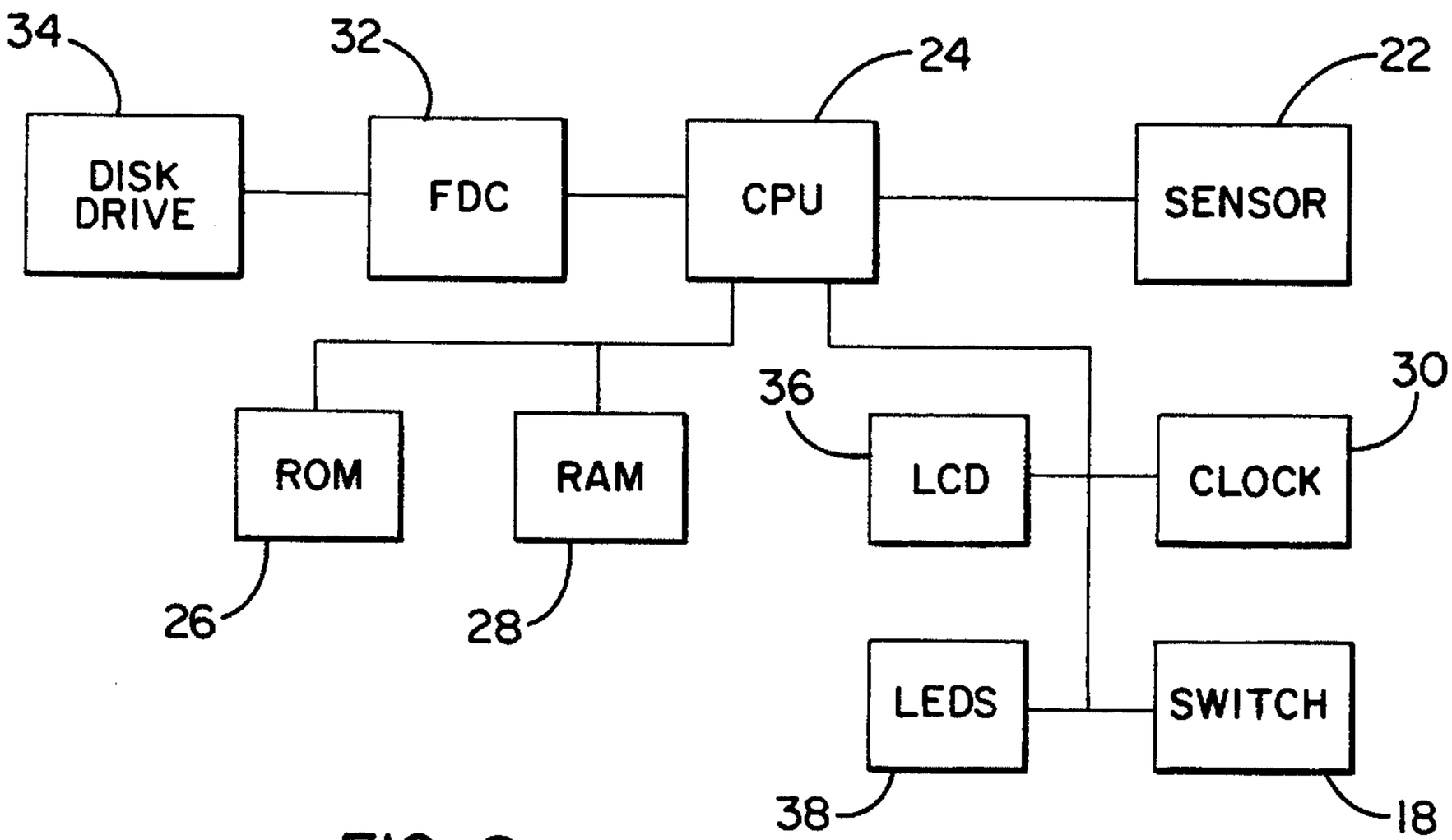

34
32
24
22
DISK DRIVE
FDC
CPU
SENSOR
ROM
RAM
36
LCD
CLOCK
30
26
28
LEDS
SWITCH
38
18

FIG. 2

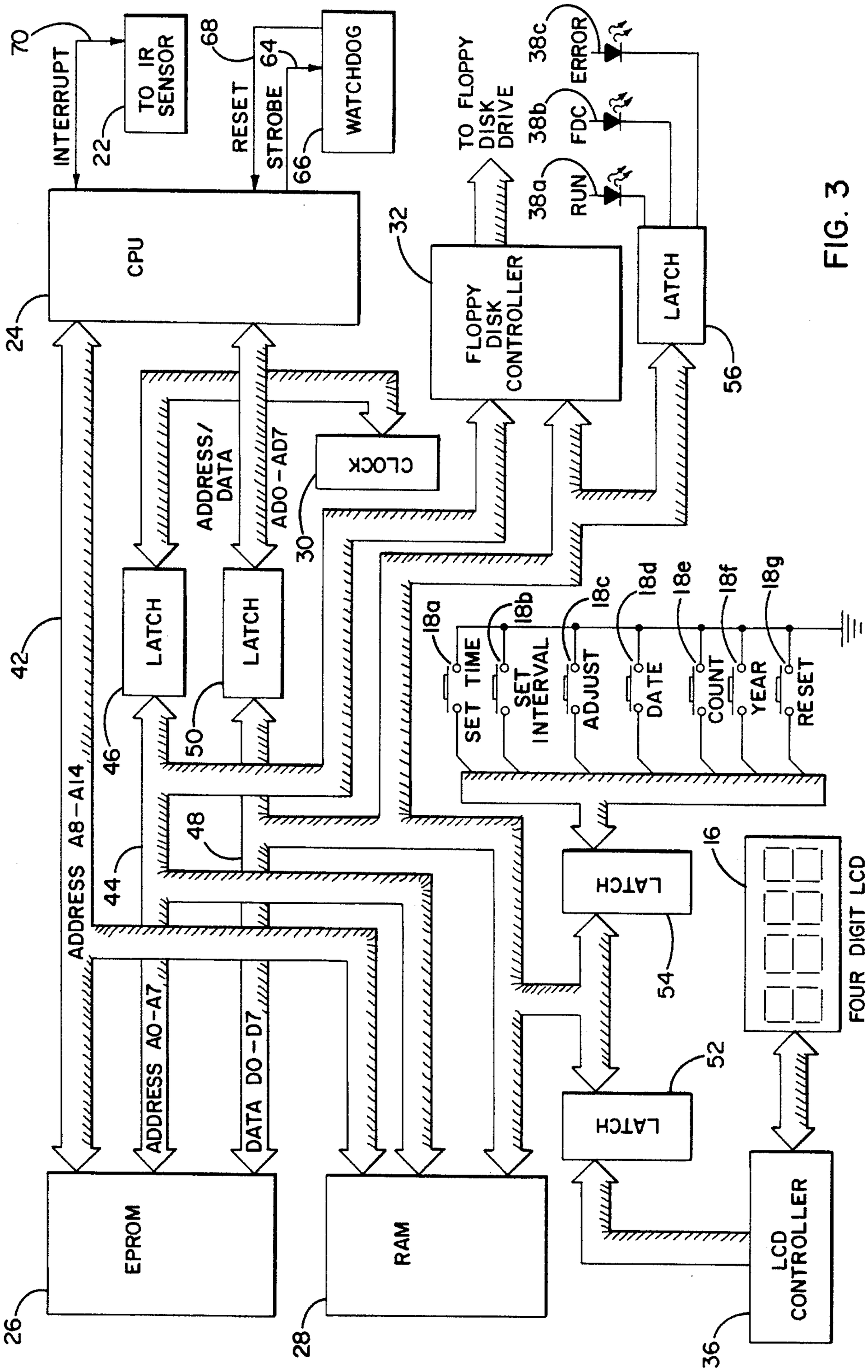

CPU
EPROM
RAM
LATCH
LATCH
LATCH
LATCH
FLOPPY DISK CONTROLLER
CLOCK
TO IR SENSOR
WATCHDOG
TO FLOPPY DISK DRIVE
INTERRUPT
RESET
STROBE
ADDRESS/ DATA
AD0-AD7
ADDRESS A8-A14
ADDRESS A0-A7
DATA D0-D7
SET TIME
SET INTERVAL
ADJUST
DATE
COUNT
YEAR
RESET
RUN
FDC
ERROR
FOUR DIGIT LCD
LCD CONTROLLER
22
24
26
28
30
32
36
38a
38b
38c
42
44
46
48
50
52
54
56
64
66
68
70
16
18a
18b
18c
18d
18e
18f
18g

FIG. 3

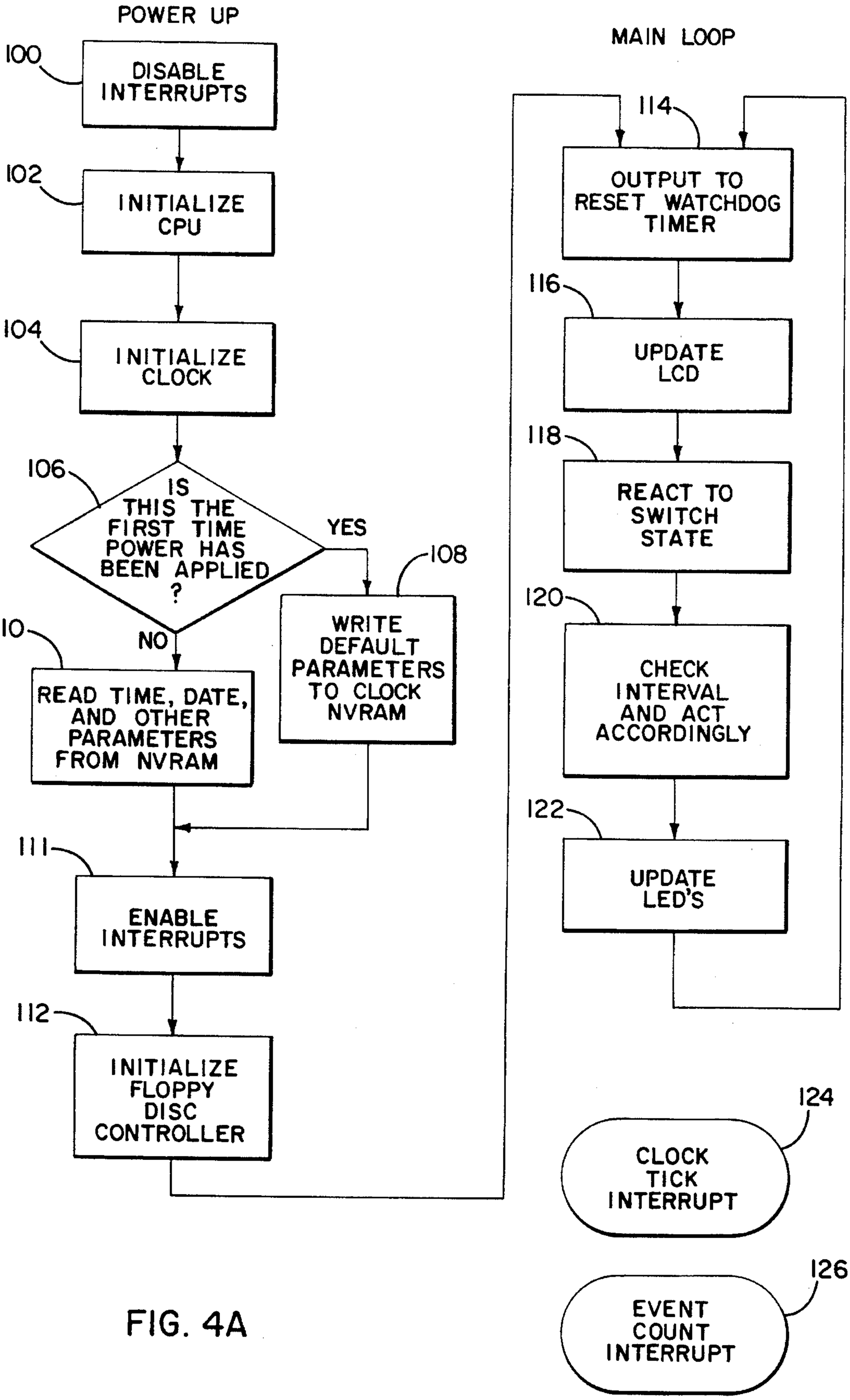
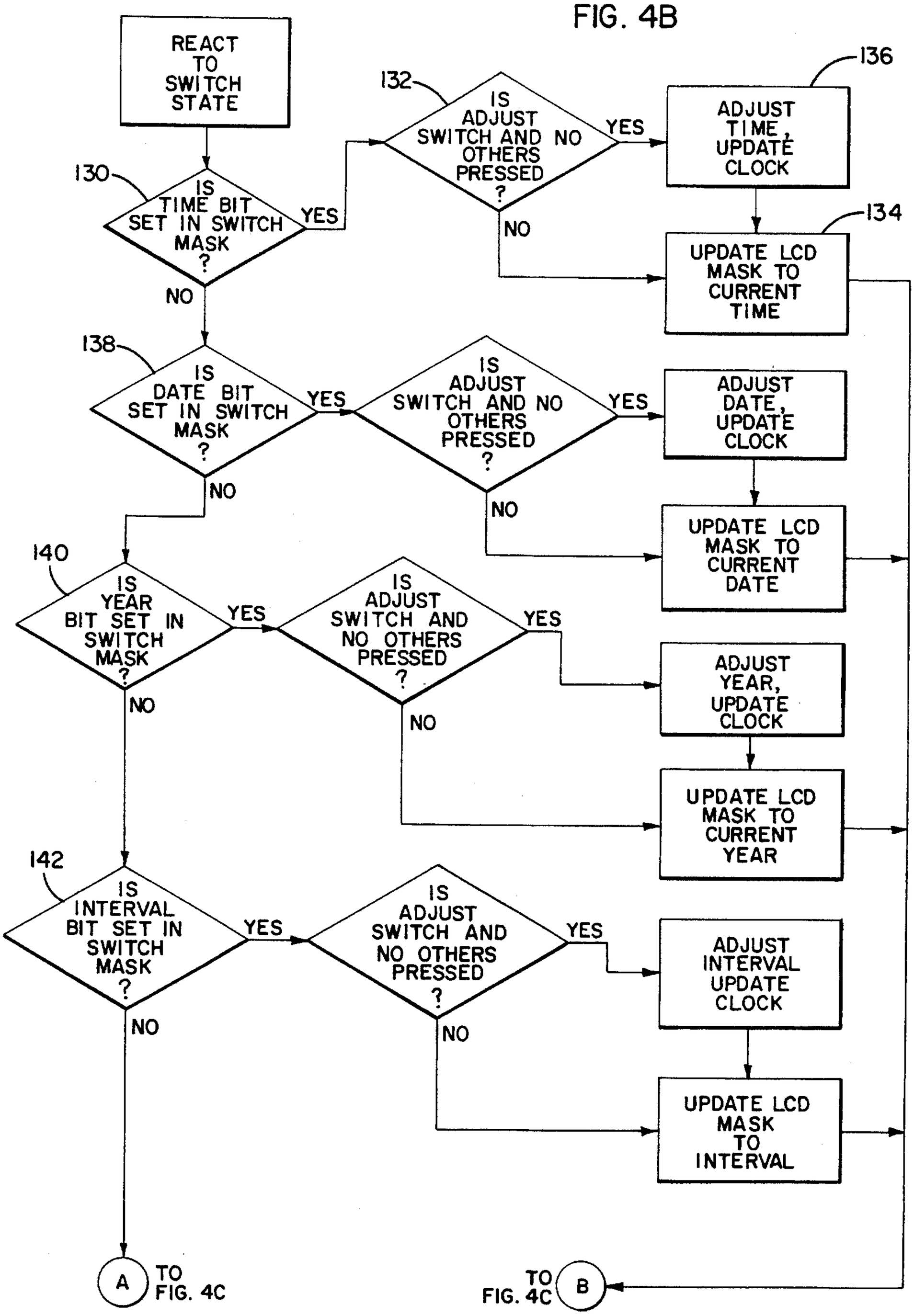

POWER UP
100
DISABLE INTERRUPTS
102
INITIALIZE CPU
104
INITIALIZE CLOCK
106
IS THIS THE FIRST TIME POWER HAS BEEN APPLIED ?
YES
108
WRITE DEFAULT PARAMETERS TO CLOCK NVRAM
NO
110
READ TIME, DATE, AND OTHER PARAMETERS FROM NVRAM
111
ENABLE INTERRUPTS
112
INITIALIZE FLOPPY DISC CONTROLLER
MAIN LOOP
114
OUTPUT TO RESET WATCHDOG TIMER
116
UPDATE LCD
118
REACT TO SWITCH STATE
120
CHECK INTERVAL AND ACT ACCORDINGLY
122
UPDATE LED'S
124
CLOCK TICK INTERRUPT
126
EVENT COUNT INTERRUPT

FIG. 4A

FIG. 4B


REACT TO SWITCH STATE
130
IS TIME BIT SET IN SWITCH MASK ?
YES
NO
132
IS ADJUST SWITCH AND NO OTHERS PRESSED ?
YES
NO
136
ADJUST TIME, UPDATE CLOCK
134
UPDATE LCD MASK TO CURRENT TIME
138
IS DATE BIT SET IN SWITCH MASK ?
YES
NO
IS ADJUST SWITCH AND NO OTHERS PRESSED ?
YES
NO
ADJUST DATE, UPDATE CLOCK
UPDATE LCD MASK TO CURRENT DATE
140
IS YEAR BIT SET IN SWITCH MASK ?
YES
NO
IS ADJUST SWITCH AND NO OTHERS PRESSED ?
YES
NO
ADJUST YEAR, UPDATE CLOCK
UPDATE LCD MASK TO CURRENT YEAR
142
IS INTERVAL BIT SET IN SWITCH MASK ?
YES
NO
IS ADJUST SWITCH AND NO OTHERS PRESSED ?
YES
NO
ADJUST INTERVAL UPDATE CLOCK
UPDATE LCD MASK TO INTERVAL
A
TO FIG. 4C
TO FIG. 4C
B

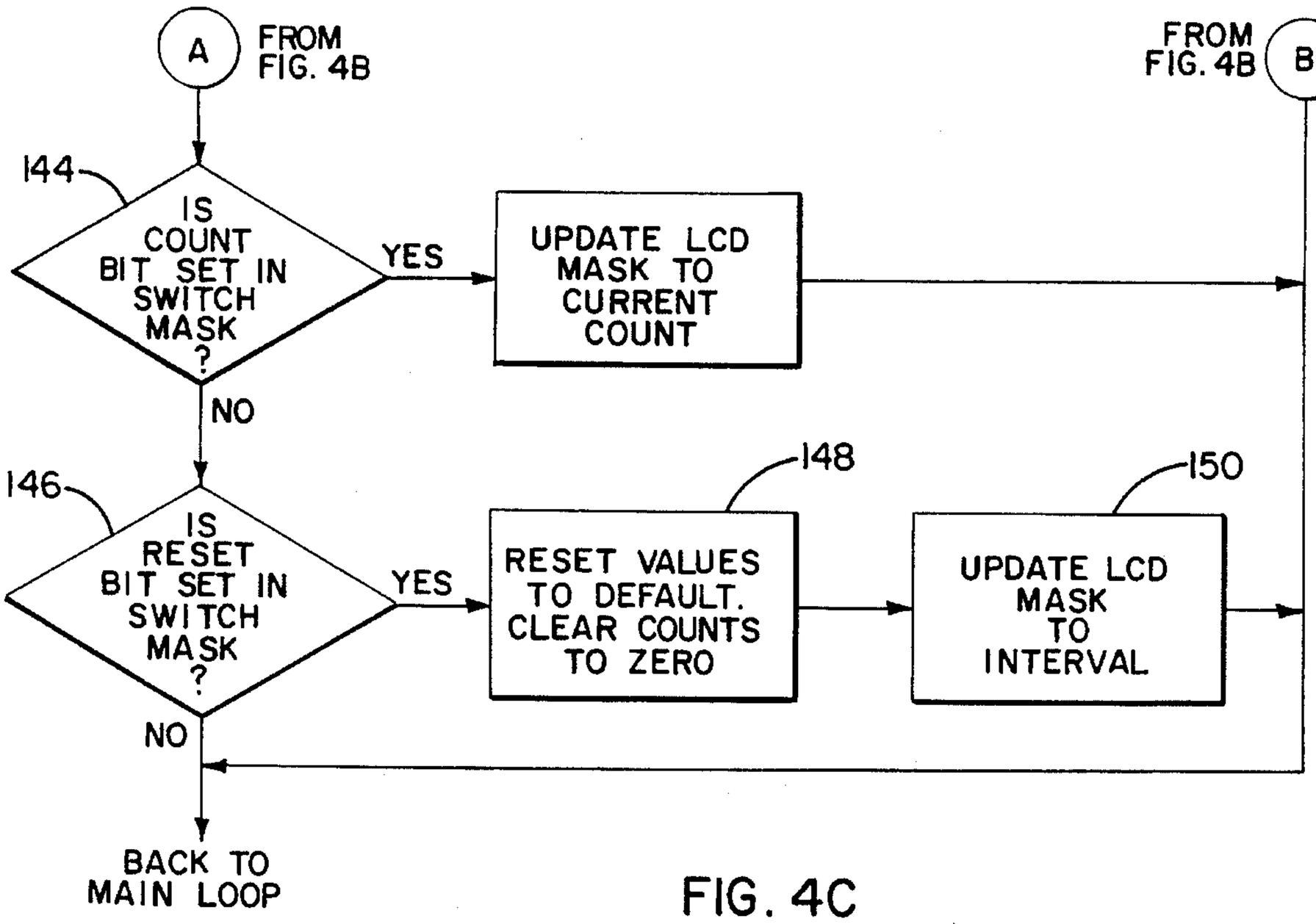


FIG. 4C

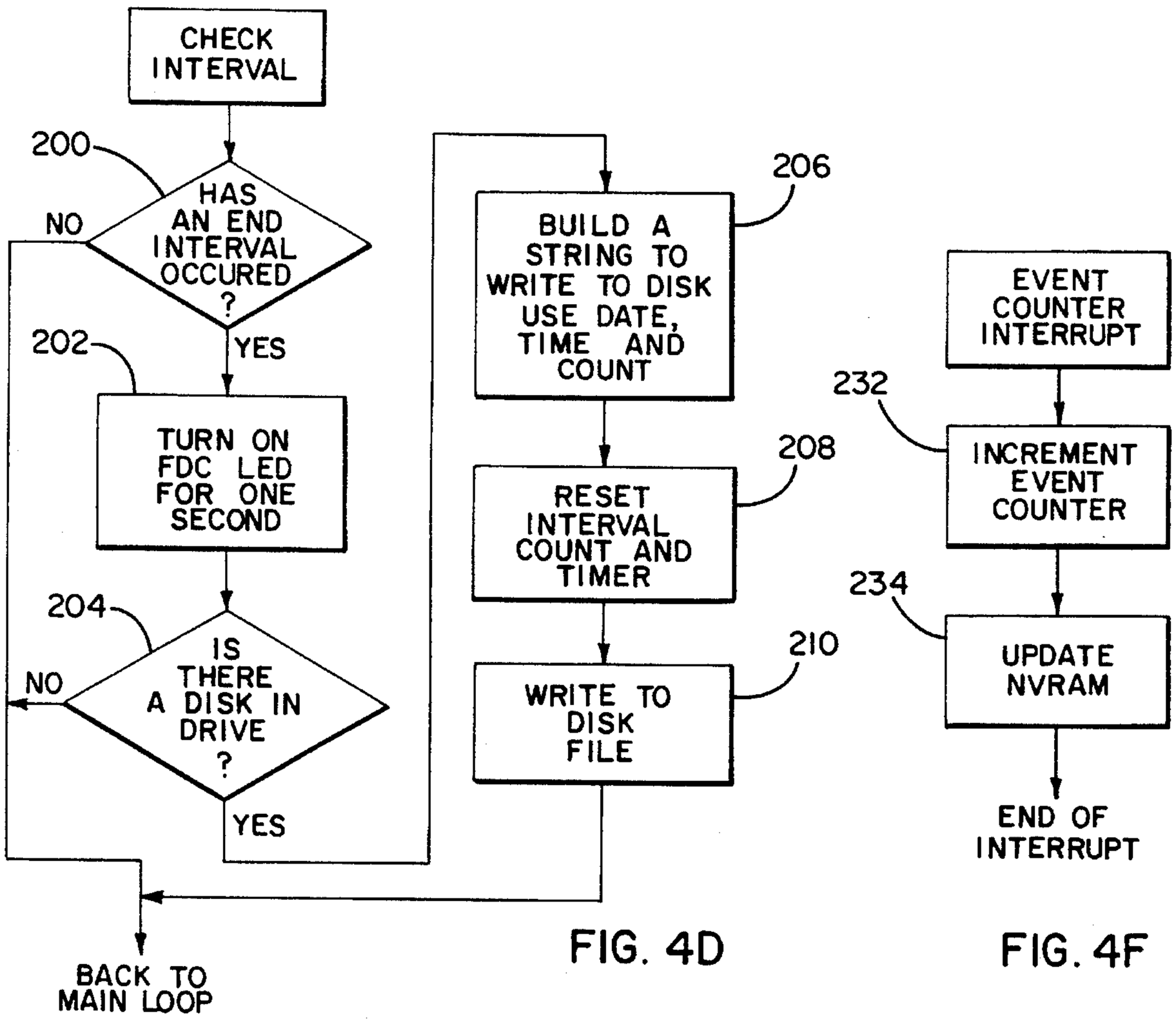


FIG. 4D

FIG. 4F

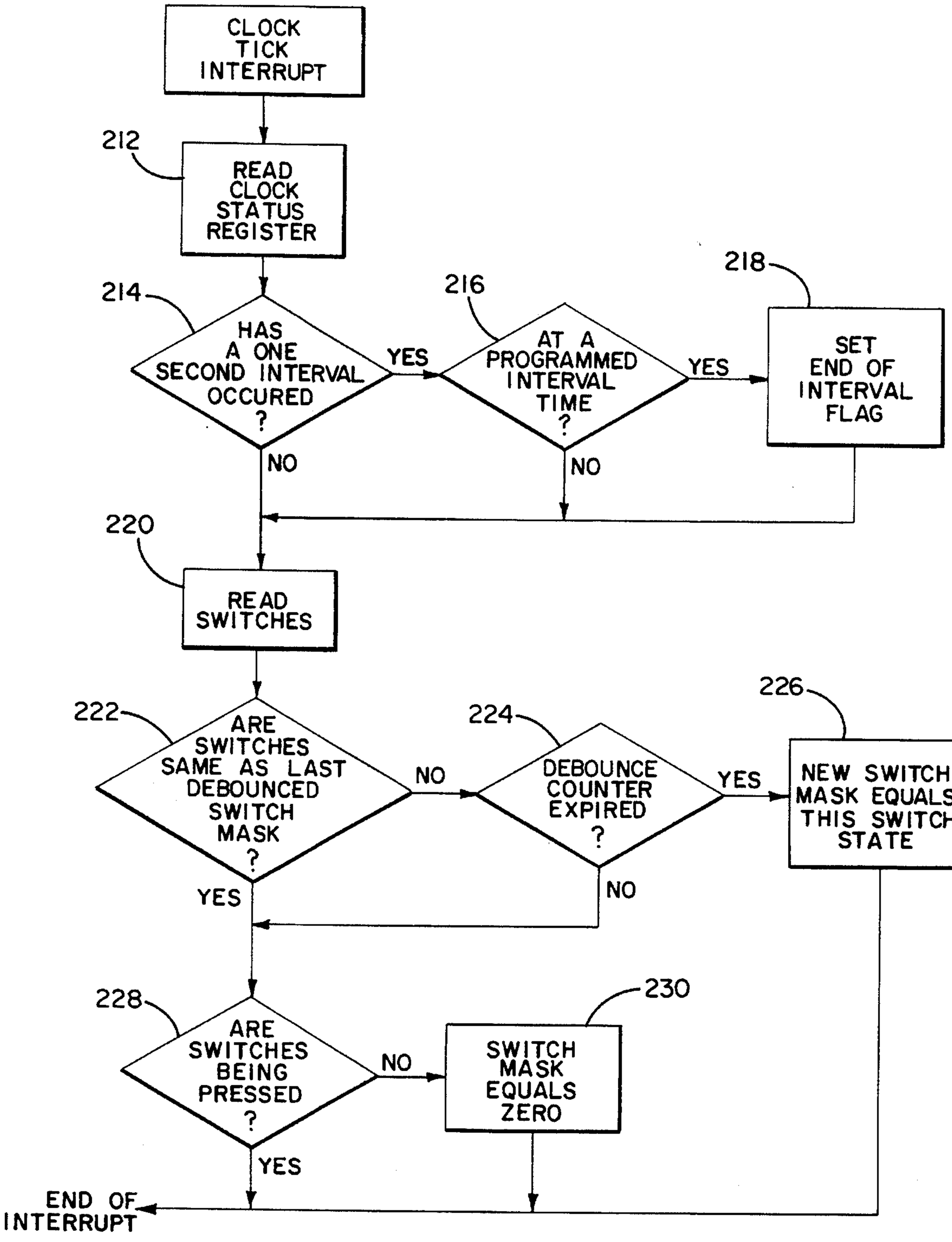

CLOCK TICK INTERRUPT
212
READ CLOCK STATUS REGISTER
214
HAS A ONE SECOND INTERVAL OCCURED ?
YES
216
AT A PROGRAMMED INTERVAL TIME ?
YES
218
SET END OF INTERVAL FLAG
NO
NO
220
READ SWITCHES
222
ARE SWITCHES SAME AS LAST DEBOUNCED SWITCH MASK ?
NO
224
DEBOUNCE COUNTER EXPIRED ?
YES
226
NEW SWITCH MASK EQUALS THIS SWITCH STATE
YES
NO
228
ARE SWITCHES BEING PRESSED ?
NO
230
SWITCH MASK EQUALS ZERO
YES
END OF INTERRUPT

FIG. 4E

PORTABLE COUNTER AND DATA STORAGE SYSTEM

FIELD OF THE INVENTION

This invention relates to a counter and data storage system for monitoring traffic flow in a defined space. The system is self-contained within a compact enclosure and generates data corresponding to the number of persons passing into the defined space, within a preset time interval. Such data, as well as a time and date stamp of such time interval, is written to a data storage unit, preferably on a floppy disk, which may easily be removed and utilized for further processing.

BACKGROUND OF THE INVENTION

It is a desirable marketing technique to obtain statistical information concerning the traffic flow of individuals passing into a defined space in numerous retail and other commercial settings. This information, once obtained, is often utilized for various marketing and promotional strategies. For example, such information may be used for the strategic placement of advertising and promotional materials or other items within a store. In other instances, such information can be used to identify "dead spots" within a store. In this way, the efficiency of use of the space may be maximized. Likewise, such information may be used to determine whether a particular location is a viable location for a new business.

Heretofore, tracking systems used in commercial settings have typically comprised sophisticated and costly video equipment coupled with other dedicated data processing units for monitoring traffic flow in specified areas. The video equipment obtains sensing information and then sends such information, via radio frequency transmission, to the processing units. In other instances, prior systems utilize a plurality of infrared sensors that are installed in the ceilings at each aisle in a grocery store that track shopping carts passing thereby. These systems also provide circuitry, located on the shopping carts, to communicate with the sensing equipment. The carts also include displays to provide information to shoppers, while being monitored by the sensing equipment.

In still other instances, tracking systems are employed, but not for the purposes of counting traffic. For example, U.S. Pat. No. 5,119,087, issued to Lucas, discloses a shipping cart retrieval system that is used to count shopping carts. Each of the carts are equipped with a "target" that is detected by a sensor which provides an output pulse upon the detection of a cart to generate an accumulated count. The accumulated count is then compared with a predetermined value, and an alarm sounds upon the detection of a match with a prize being typically awarded to the person returning the cart. The purpose of this system, however, is to provide an incentive to return shopping carts to the store and not for monitoring traffic flow.

Other systems are known which generally monitor individuals. Likewise, they are not suited for obtaining data corresponding to traffic flow in a retail setting. For example, Koelsch's U.S. Pat. No. 4,847,485 discloses a system for monitoring the number of persons inside a pass-through by detecting and counting persons within a defined space and determining the direction of movement of the individuals. Koelsch's device, however, is used to prevent unauthorized entry or passage through a controlled portal.

Thus, apart from the dedicated complex tracking systems, the only other known alternative is to locate personnel near the entrance of a defined space to monitor traffic flow into and out of the space. Of course, this requires actual physical counting of persons as they pass into the designated area. This method is susceptible to human error, notwithstanding the requirement for retabulation of the data in many cases.

SUMMARY OF THE INVENTION

Thus, the prior art now fails to adequately meet the aforestated problems of providing adequate monitoring of traffic flow, at low cost, in a retail or commercial setting. Accordingly, the principle object of the present invention is to generally overcome deficiencies of the prior art.

More particularly, it is an object of the present invention to provide a counter and data storage system that is a contained within a portable enclosure, which can be readily installed and removed.

It is at a further object of the present invention to provide improved traffic monitoring in a counting and data storage system that includes a removable data storage device, so that accumulated data may be periodically removed for further processing.

The present invention provides these and other additional objects through an improved, low cost, counting and data storage system that is contained substantially within an enclosure. The system includes an infrared sensor located proximate a defined area to be monitored. The sensor is preferably disposed on the exterior of the enclosure and detects the presence of individuals passing into the area and provides a first signal. An input selector located within the enclosure permits the selection of a desired count interval. In addition, a control circuit also contained within the enclosure is coupled with the sensor and the input selector. The control circuit receives the first signal and provides count data including a count of individuals within the preset time interval, along with a date and time stamp corresponding with the time interval. The system also includes a removable data storage device located within the enclosure that stores the count data written thereto by the control circuit. Preferably, the data storage device is a 3.5 inch floppy disk, which may be readily removed from the system so that the count data may be periodically removed and analyzed at a remote location.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a an isometric view of a counting and data storage system of the present invention.

FIG. **2** is a simplified block diagram of circuitry utilized to implement the preferred embodiment of the counting and data storage system shown in FIG. **1**.

FIG. **3** is a more detailed block diagram representation of FIG. **2**.

FIGS. **4***a–f* depict a logical flow diagram showing operation of the circuitry shown in FIGS. **2** and **3**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Generally, the present invention relates to a counting and data storage system that is low cost and easy to use. The system of the present invention monitors traffic flow within a selected area and periodically stores data corresponding to the number of individuals passing within a defined space in a selected time interval, along with a date and time stamp,

on a removable data storage device. The counting system is substantially self-contained within a compact enclosure that ensures portability, while being readily concealed from the public.

FIG. **1** shows a counting and data storage unit **10** according to the present invention. The unit **10** comprises an enclosure **12** that houses circuitry, as described below, and a data storage unit shown as a floppy disk **14**. The unit **10** also includes a digital display **16** that provides output information to the user. In the preferred embodiment, the enclosure **12** houses various manual input selectors **18** which enables selection of various input parameters, as described in greater detail below. In addition, the enclosure **10** houses a plurality of warning and status indicator lamps **38** that also provide information to the user.

The enclosure **12** is coupled via cable **20** to an infrared sensor **22** that is placed proximate the entrance of the defined space to be monitored. The sensor **22** is preferably not contained within the enclosure **12** in order to provide greater flexibility in positioning the sensor **22**, while concealing the enclosure from view by individuals passing thereby. The sensor **22**, however, may also be included within the enclosure **12** and operate just as well. In the preferred embodiment, the sensor **22** is a reflective infrared sensor that provides an output signal upon the detection of an absence of a reflection, that is, when an individual interrupts the beam transmitted by the sensor **22**. Those skilled in the art will appreciate that multiple sensors may be employed to obtain directional information within the defined area with appropriate modification.

The unit **10** (as well as the sensor **22**) is preferably located near the entrance of the location that is being monitored, and is particularly suited for a retail or other commercial environment. Thus, for example, the unit may be placed at the entrance of a shopping center, the entrance of a store within the shopping center, or even in a specialty department within the store. By monitoring traffic flow into any of these areas, the invention provides an accurate count of number of persons sensed within a selected count interval for a given date and time. The invention stores this count data information on a removable data storage device so that the count data can be easily analyzed at a remote location.

FIG. **2** shows a simplified block diagram representation of the electrical circuitry for the operation and control of the system that is contained within the unit **10**. As shown therein, the system comprises a microprocessor (CPU) **24** that operates in logical fashion under control of program instructions contained in read-only memory (ROM) **26**. The CPU **24** is also coupled with random-access memory (RAM) **28** to store intermediate operations as well as count data and the like as will be understood by those skilled in the art. The CPU **24** is also coupled with a clock circuit **30** that provides time and date stamp information, as described in greater detail below.

The CPU **24** receives input signals from the sensor **22** corresponding to the detection of an individual passing through a selected area. Likewise, the CPU **24** receives input information from manual selector switches **18**. As best seen in FIG. **3**, these selectors **18** include selection of a desired count interval denoted as selector **18***b*, a set time selector denoted by selector **18***a*, an adjust selector **18***c*, a year selector **18***d*, and a reset selector **18***e*. The selectors provide input information to the CPU corresponding to an external time and date adjust, as well as a count interval adjust.

The CPU **24** provides output control signals to a disk controller **32**, which in turn, provides control for a floppy disk drive **34**. In this way, count data including a time and date stamp, and a count of individuals into a defined area within a selected time interval, is written to a disk file. The CPU **24** also provides control and data signals to an LCD control and driver **36**. In response, the LCD control and driver **36** provides output signals to the digital display **16** (see FIG. **1**). The processor **24** also provides output signals to warning and status indicator lamps, shown as LEDs **38***a–c*.

FIG. **3** is a more detailed block diagram representation of the counter and data storage unit **10**. As shown therein, the CPU **24** is connected to the ROM and RAM memories **26**, **28** via address bus **42** and address bus **44**. Bus **44** includes a data latch **46** to permit synchronization to and from the processor **24**. A data bus **48** also couples the ROM and RAM memories **26** and **28** with the CPU **24** through data latch **50**. A clock circuit **30** is also connected to address and data bus **44** and **48** and is coupled with the processor **24**.

The floppy disk controller **32** receives program instructions directly from memory **26** and also has direct memory access to memory **28** via bus **44** and **48**. The controller **32** provides output signals to a floppy disk drive circuit as would be understood by those skilled in the art.

A plurality of input selectors **18***a–e* are also shown as control input selectors **18** in FIG. **1**. These selectors are coupled via latch **54** to address/data bus **48**. Bus **48** is also connected via data latch **56** to a plurality of indicator lamps **38***a*, **38***b* and **38***c*. As shown in FIG. **3**, these lamps correspond to normal operation, floppy disk controller operation and error detection, respectively.

The LCD controller circuit **36** is coupled through data latch **52** to the address/data bus **38**. The LCD controller **36**, in turn, provides output signals to the display **16**, which is preferably a four digit liquid crystal display. In the preferred embodiment, the display normally provides an output of the date. By depressing the selectors **18**, the display also provides an output of the time, and a running count for the current count interval, as described in greater detail below.

In addition, the CPU **24** periodically provides a strobe signal on a line **64** to a watchdog circuit **66**. The failure of the processor **24** to provide this signal within a predetermined time interval indicates program malfunction. The absence of the strobe signal causes the watchdog circuit **66** to provide a reset signal on a line **68** to the CPU **24**, thus resuming normal operation. FIG. **3** also shows the CPU **24** coupled via the line **70** to the infrared sensor **22**. In response to the receipt of an interrupt signal from the sensor **22**, the CPU **24** provides appropriate control signals to update an event counter as well as RAM **28**. At the end of each count interval, the floppy disk controller **32** writes the accumulated count data to a disk file, as described in greater detail below.

By way of example and not by way of limitation, the circuit components for the system **10** may be of the type as follows:

Reference Numeral	Type
22	42SRU
24	80C188
26	EPROM 27C256
28	RAM 62256
30	DS 1287
32	82077
36	TC7211A
66	MAX 1232

-continued

Reference Numeral	Type
46, 52, 54, 56	74HC573
50	74HC245

FIGS. **4***a–f* illustrate a logical flow diagram of the data storage system of the present invention. As shown jointly in FIGS. **3** and **4***a*, the system begins by disabling the interrupts (described hereinafter) at a block **100** and then proceeds to initialize the CPU **24** and clock and start the clock circuit **30** (see FIG. **3**) at a block **102** (FIG. **4***a*). Next the system proceeds to decision block **106** and determines if power has previously been applied to the unit. If this is the first time on, the default operating parameters are loaded to system memory at a block **108**. Otherwise, the previously saved valves stored in non-volatile memory of the clock are loaded as the system parameters at a block **110**. The system then advances to a block **111** where the CPU **24** is enabled to receive interrupts. Thereafter, at a block **112**, the floppy disk controller **32** is initialized.

The system then advances to a background program or main operating loop and provides output signals to reset the watchdog timer circuit **66** at a block **114**. At a next block **116**, the system updates the LCD controller **36**. The system then advances to a subroutine shown by a block **118** where the system reacts to the current state of manual input selectors **18***a–g*, as described in greater detail below. Next, the system advances to a next subroutine shown by a block **120** and checks whether the selected time interval has elapsed. The system then updates output supplied to the indicator lights at block **122**. Finally, the system returns to block **114** and continues.

FIG. **4***a* also shows a "clock tick" interrupt routine denoted by a block **124** and an event count interrupt routine denoted by block **126** which are processed on the occurrence of the interrupt. These interrupts are shown in greater detail in FIGS. **4***e* and **4***f*, respectively.

FIGS. **4***b–c* show the details of the react to switch routine (denoted by the block **118** in FIG. **4***a*) wherein the state of manual input selectors **18***a–g* is examined. In the preferred embodiment, all selector input scanning is performed during the "clock tick" interrupt routine (block **124**). This interrupt routine then sets the appropriate bits in a switch mask byte to reflect the state of the switches. The switches are used to adjust time, date, count interval, and for viewing the current count.

The react to switch state routine begins at a decision block **130** where the system determines whether the time bit is set in the switch mask byte which indicates that the set time switch **18***a* has been pressed. If, at block **130**, the system determines that the time bit is set, the system advances to a decision block **132** and determines whether the bit corresponding to depression of the adjust switch **18***c* is set. If no, the system advances to a block **134** and updates an LCD display word (comprising two bytes) to the current time. If, on the other hand, the adjust switch is depressed, the system advances to a block **136** and adjusts the time as well as updates the clock. Thereafter, the system updates the LCD display word to the current time at block **134** and returns to the main loop. The system examines the date bit, the year bit, and the interval bit in the switch mask byte at decision blocks **138**, **140** and **142** and updates in the same manner. In the preferred embodiment, the intervals may correspond to 1, 5, 10, 20 or 30 minutes.

The system also determines whether a count bit is set in the switch mask byte corresponding to depression of the count selector **18***e* at a decision block **144**. If yes, the system advances to a block **146** and updates the LCD display word to the current accumulated count in the interval. Thereafter the system returns to the main loop.

The system also determines whether a reset bit in the switch mask byte is set at a decision block **146**. If no, the system returns to the main loop. On the other hand, if the system determines at decision block **146** that the reset switch bit is set, the system advances to a block **148** and resets the values to default. In addition, the system clears the count to zero. The system then advances to a block **150** and updates the LCD display word to the current interval. The system then returns to the main loop.

FIG. **4***d* is a flow diagram of the check interval routine denoted by the block **120** in FIG. **4***a*. During this routine, the system advances to a decision block **200** and determines whether the end of a selected count interval is detected. The selected count interval is the desired interval at which the system writes data to the disk file. If no, the system advances to the main loop. On the other hand, if the system detects an end of the selected count interval, the system advances to a block **202** and turns on the floppy disk controller indicator lamp for one second prior to writing to the disk file. The system then advances to a decision block **204** and determines whether there is a disk present in the disk drive. If no, the error LED mask bit is set and the system returns to the main loop. If yes, the system advances to a block **206** and builds a data string to write to the disk as will be understood by those skilled in the art. Such data includes the date stamp, time stamp, numerical count and count interval. In the preferred embodiment, data corresponding to the count interval is stored as a beginning and ending time of the interval. The system then advances to a block **208** and resets the interval count and timer. Finally, the system advances to a block **210** and writes to the disk file, turns off the FDC indicator lamp, and then returns to the main loop and continues.

FIG. **4***e* is a more detailed diagram of the "clock tick" interrupt denoted by the block **124** in FIG. **4***a*. The "clock tick" interrupt operates on receipt of an output signal from the clock chip that occurs 16 times per second. During this interrupt, the system first receives the "clock tick" interrupt. The system then advances to a block **212** and reads the status register of the clock circuit. Next, the system advances to a decision block **214** and determines from the status byte read from the status register in the clock chip whether a one second interval has occurred. If yes, the system advances to a decision block **216** and determines whether the interval has occurred at a programmed interval time. If yes, the system advances to a block **218** and sets an end of interval flag. The system then branches to a block **220** and reads the selector switches. On the other hand, if at either decision block **214** or **216**, the system determines that one second interval has not occurred or that the interval has not occurred at a programmed time interval, the system advances to a block **220**. The system then advances to a decision block **222** and determines whether the switches are the same as the last debounce switch mask. If no, the system determines whether the debounce counter has expired as a decision block **224**. If at decision block **224**, the counter has expired, the system advances to a block **226** and sets the new switch mask equal to the detected states of the selector switches. The system then terminates the interrupt.

On the other hand, if either at decision block **222** the switches are not the same as the last debounce switch mask or at decision block **224** the debounce counter has not expired, the system advances to a decision block **228** and

determines whether any switches are being pressed. If yes, the system terminates the interrupt. If at decision block **228** the system detects that no switches are being pressed, the system advances to a block **230** and sets the switch mask equal to zero. The system then terminates the interrupt.

FIG. **4***f* is a more detailed flow diagram of the event counter interrupt **126**. As shown therein, upon receipt of the event counter interrupt signal, the system advances to a block **232** and increments the event counter. The system then advances to a block **234** and updates the nonvolatile memory in the clock chip. The system then terminates the interrupt.

Various advantages flow readily from the disclosed counting and data storage system. For example, the system of this invention achieves an extremely accurate count of individuals that enter a specified area within a desired time interval. In addition, a dramatic decrease in the amount of equipment is required to provide more useful information in the same commercial environment. That is, where a previous system may employ video equipment in conjunction with dedicated computer equipment, the present invention can provide the same information, with a substantially self-contained and compact unit, from which data can be readily be transferred for further processing. Likewise, the unit can be easily moved to various locations with minimum effort. Thus, the present invention provides significant improvements over the prior art, improvements that are manifested in improved performance and diminished cost.

Accordingly, a counting and data storage system meeting the aforestated objectives has been described. The counting system is easily preset to provide monitoring of individuals within a selected time interval, while being substantially self-contained. Various modifications as would be apparent to one of ordinary skill in the art and familiar with the teaching of this application are deemed to be within the scope of this invention. The precise scope of the invention is set forth in the appended claims.

What is claimed is:

1. A system for monitoring traffic flow of individuals passing a selected location comprising:

a portable enclosure;

sensor means located at the selected area and coupled with the enclosure for detecting the presence of an individual passing into the selected area and for providing a first signal;

an input selector disposed on the portable enclosure for permitting the selection of a desired count interval;

a computing and control circuit contained within the enclosure and coupled with the sensor means and the input selector, the computing and control circuit receiving the first signal and providing count data corresponding to a count of individuals within the preset time interval and a date and time stamp; and,

a data storage controller circuit contained within the enclosure and coupled with the computing and control circuit for writing the count data to a data storage device, the data storage device being selectively removable from the enclosure.

2. The invention as in claim **1** wherein the data storage device is a floppy disk.

3. The invention as in claim **2** further comprising a display coupled with the processor for providing output information corresponding to the count data.

4. The invention as in claim **1** wherein the count data includes the date and time corresponding to the count and time interval.

5. The invention as in claim **1** wherein the sensor means is a reflective infrared detector.

6. A counting and data storage system for monitoring individuals passing a selected location comprising:

sensor means located at the selected area for detecting the presence of an individual passing into the selected area and for providing a first signal;

input selector means for permitting the selection of a desired count interval;

control means coupled with the sensor means and the input selector means, the control means receiving the first signal and for providing count data including a count of individuals within the preset time interval and a date and time stamp;

a transportable data storage device for storing the count data supplied by the control means; and,

a portable enclosure housing the input selector means, the control means, and the data storage device, the enclosure permitting hand access and selective removal of the data storage device.

7. A counting and data storage system for monitoring individuals passing into a selected location comprising:

a sensing unit located at the selected location including a first sensor and a second sensor disposed proximate the first sensor, the first and second sensors detecting the presence of an individual passing into the selected area and providing first and second signals;

a portable enclosure;

a computing and control circuit disposed within the portable enclosure and coupled with the sensing unit receiving the first and second signals and for providing count data including a count of individuals entering the selected location within a preset time interval and date and time stamp; and,

a data storage device selectively removable from the enclosure for storing the count data supplied by the computing and control circuit.

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